CLAIMS

What is Claimed is:

1. A method of acquiring ultrasound response data for vascular tissue, comprising:

inserting at least a portion of a catheter into a vascular structure;

activating a transducer portion of said catheter, said activation of said transducer portion resulting in an ultrasound signal being transmitted toward vascular tissue;

acquiring backscattered ultrasound data from said vascular tissue;

using at least a portion of said backscattered ultrasound data and an algorithm to estimate the transfer function of said catheter while said catheter is inside said vascular structure; and

using at least said transfer function to calculate ultrasound response data for said vascular tissue, wherein said ultrasound response data is (i) indicative of data that is backscattered from said vascular tissue and (ii) substantially independent from ultrasound data modifications resulting from said catheter.

2. The method of Claim 1, further comprising the step of filtering noise from said backscattered ultrasound data.

3. The method of Claim 1, wherein said algorithm is an iterative algorithm that is time-invariant over small intervals.

4. The method of Claim 1, wherein said step of using at least a portion of said backscatter ultrasound data and said algorithm to estimate the transfer function of said catheter further comprises the step of using an error-criteria algorithm and a least-squares-fit algorithm to estimate ultrasound response data for said vascular tissue and said transfer function of said catheter, respectively.

5. The method of Claim 4, further comprising the step of using said estimated ultrasound response data and said calculated ultrasound response data to calculate final ultrasound response data for said vascular tissue.

6. The method of Claim 1, further comprising the step of using at least said ultrasound response data to produce an ultrasound image of at least said vascular tissue.

7. The method of Claim 1, further comprising the steps of:

identifying a plurality of parameters of said ultrasound response data; and

using said plurality of parameters and previously stored histology data to characterize at least a portion of said vascular tissue.

8. The method of Claim 7, further comprising the steps of:

transforming said ultrasound response data from the time domain into the frequency domain; and

identifying at least two of said plurality of parameters from the frequency spectrum of said ultrasound response data.

9. The method of Claim 8, wherein said step of identifying said at least two of said plurality of parameters further comprises said at least two parameters being selected from a group consisting of maximum power, minimum power, frequency at maximum power, frequency at minimum power, y intercept, slope, mid-band fit, and integrated backscatter.

10. The method of Claim 7, wherein said step of using said plurality of parameters and previously stored histology data to characterize at least a portion of said vascular tissue further comprises using said plurality of parameters and said previously stored histology data to identify a tissue type of at least a portion of said vascular tissue, said tissue type being selected from a group consisting of fibrous tissues, fibro-lipidic tissues, calcified necrotic tissues, and calcific tissues.

11. The method of Claim 10, further comprising the step of using at least said identified tissue type to produce a tissue-characterization image of at least said portion of said vascular tissue on a display.

12. The method of Claim 1, further comprising the steps of:

transmitting a second ultrasound signal toward a tissue portion of said vascular structure, said tissue portion being at least partially distinct from said vascular tissue;

acquiring ultrasound data backscattered from said tissue portion;

using at least a portion of said ultrasound data and said algorithm to estimate a second transfer function of said catheter while said catheter is inside said vascular structure; and

using at least said second transfer function to calculate response data for said tissue portion.

13. An intravascular-ultrasound (IVUS) data-acquisition system, comprising

a catheter comprising at least one transducer and adapted to transmit an ultrasound signal and to receive a backscatter of said ultrasound signal; and

a computing device electrically connected to said catheter and comprising a transfer-function application adapted to:

receive ultrasound data from said catheter, said ultrasound data being backscattered from vascular tissue;

estimate the transfer function of said catheter from said ultrasound data; and

determine ultrasound response data for said vascular tissue, said ultrasound data being a function of at least said transfer function and said ultrasound response data.

14. The IVUS-data-acquisition system of Claim 13, wherein said transfer-function application is further adapted to calculate said ultrasound response data from said ultrasound data and said transfer function.

15. The IVUS-data-acquisition system of Claim 13, wherein said transfer-function application is further adapted to estimate said ultrasound response data from said ultrasound data.

16. The IVUS-data-acquisition system of Claim 15, wherein said transfer-function application is further adapted to:

estimate a first set of ultrasound response data from said ultrasound data;

calculate a second set of ultrasound response data from said ultrasound data and said transfer function; and

use said first and second sets of ultrasound response data to calculate said ultrasound response data.

17. The IVUS-data-acquisition system of Claim 13, wherein said transfer-function application is further adapted to filter noise from said ultrasound data, said ultrasound data being a function of at least said transfer function, said ultrasound response data, and said noise.

18. The IVUS-data-acquisition system of Claim 13, wherein said transfer-function application is further adapted to estimate the transfer function of said catheter through the use of an iterative algorithm that is time-invariant over small intervals.

19. The IVUS-data-acquisition system of Claim 18, wherein said transfer function application is further adapted to estimate the transfer function of said catheter through the use of at least one algorithm, said at least one algorithm being selected from a list consisting of an error-criteria algorithm and a least-squares-fit algorithm.

20. The IVUS-data-acquisition system of Claim 13, wherein said catheter further comprises an array of transducers circumferentially positioned around said catheter.

21. The IVUS-data-acquisition system of Claim 13, wherein said computing device further comprises:

a database adapted to store a plurality of parameters corresponding to a plurality of vascular tissue types; and

a characterization application electrically connected to said database and said transfer-function application and adapted to:

receive said ultrasound response data;

transform said ultrasound response data into the frequency domain;

analyze said transformed signal for a plurality of identifiable parameters; and

use said plurality of identifiable parameters and at least a portion of said plurality of parameters stored in said database to characterize at least a portion of said vascular tissue.

22. The IVUS-data-acquisition system of Claim 21, wherein said database is further adapted to store at least two parameters corresponding to said plurality of vascular tissue types, said at least two parameters being selected from a group consisting of maximum power, minimum power, frequency at maximum power, frequency at minimum power, y intercept, slope, mid-band fit, and integrated backscatter.

23. The IVUS-data-acquisition system of Claim 21, wherein said characterization application is further adapted to use said plurality of identifiable parameters and said at least a portion of said plurality of parameters stored in said database to identify the tissue type of said at least a portion of said vascular tissue, said tissue types being selected from a group consisting of fibrous tissues, fibro-lipidic tissue, calcified necrotic tissues, and calcific tissues.

24. The IVUS-data-acquisition system of Claim 23, wherein said computing device further comprises a display for imaging said at least a portion of said vascular tissue in a color corresponding to said tissue type.

25. The IVUS-data-acquisition system of Claim 13, wherein said catheter is further adapted to transmit multiple ultrasound signals and to receive multiple backscatters therefrom while said catheter is within a particular vascular structure, and said transfer-function application is further adapted to:

receive said backscatters from said catheter;

estimate multiple transfer functions of said catheter from said backscattered data; and

use said multiple transfer functions to determine multiple sets of response data.

26. A vascular-tissue-characterization system, comprising:

a catheter comprising at least one transducer and adapted to transmit an ultrasound signal and to receive a backscatter of said ultrasound signal;

an intravascular ultrasound (IVUS) console electrically connected to said catheter and adapted to receive ultrasound data from said catheter, said ultrasound data being backscattered from vascular tissue;

a transfer-function application adapted to:

use the ultrasound data backscattered from said vascular tissue to estimate the transfer function of said catheter; and

use at least said transfer function to calculate a response-data portion of said ultrasound data; and

a computing device electrically connected to said IVUS console, comprising:

a database adapted to store a plurality of parameters corresponding to a plurality of vascular tissue types; and

a characterization application electrically connected to said database and adapted to:

analyze said response-data portion of said ultrasound data for a plurality of identifiable parameters; and

use said plurality of identifiable parameters and at least a portion of said plurality of parameters stored in said database to characterize at least a portion of said vascular tissue.

27. The vascular-tissue-characterization system of Claim 26, wherein said transfer-function application is operating on said computing device.

28. The vascular-tissue-characterization system of Claim 26, wherein said transfer-function application is operating on said IVUS console.

29. The vascular-tissue-characterization system of Claim 26, wherein said transfer-function application is further adapted to filter noise from said ultrasound data.

30. The vascular-tissue-characterization system of Claim 26, wherein said catheter further comprises an array of transducers circumferentially positioned around said catheter.

31. The vascular-tissue-characterization system of Claim 26, wherein said catheter further comprises a single transducer adapted for rotation about said catheter.

32. The vascular-tissue-characterization system of Claim 26, wherein said characterization application is further adapted to transform said response-data portion of said ultrasound data into the frequency domain.

33. The vascular-tissue-characterization system of Claim 26, wherein said computing device further comprises a display and said characterization application is further adapted to produce an image of said at least a portion of said vascular tissue on said display.

34. The vascular-tissue-characterization system of Claim 26, wherein said catheter is further adapted to transmit multiple ultrasound signals and to receive multiple backscatters therefrom while said catheter is within a particular vascular structure, and said transfer-function application is further adapted to:

use said backscatters to estimate multiple transfer functions of said catheter; and

use at least said multiple transfer functions to calculate response-data-portions of said backscatters.